NRC FORM 366 (4-95)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Browns Ferry Nuclear Plant (BFN) Unit 2	05000260	1 OF 8

TITLE (4)

Reactor Scram as a Result of Personnel Error During Surveillance Testing

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									NA	
04	24	97	97	-- 001 --	00	05	23	97	NA	

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
			20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
POWER LEVEL (10)	100		20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)	X	50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mark DeRoche, Industry Affairs Specialist	(205) 729 - 4889

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On April 24, 1997, at 1814 Central Daylight Time (CDT), Unit 2 scrammed from full power due to a turbine trip caused by a high reactor water level trip signal. The main turbine and all three reactor feedwater pump turbines tripped when a high reactor water level trip signal was generated during the performance of 2-SI-4.2.B-ATU(C), Core and Containment Cooling Systems Analog Trip Unit Functional Test. The initiating high water level signal was caused by personnel error when a volt-ohm meter being used in the test was inadvertently connected across terminals of a companion Channel A relay instead of the intended Channel C relay. When Channel C was tripped per the test instruction with the meter connected to Channel A, the two out of two trip logic for high water level was completed. The Main Steam Isolation Valves (MSIV) subsequently closed from an unexpected high steam flow signal associated with the transient. The closure of the MSIVs in this event was an unexpected response to a turbine trip transient. The most probable cause of the high steam flow signal was instrumentation response to a steam line pressure wave and process noise from Main steam relief valve (MSRV) operation. Reactor water level decreased to -45 inches as a result of the loss of feedwater and the reactor pressure increase from the MSIV closure. Water level was restored and maintained by manual initiation of the Reactor Core Isolation Cooling System and automatic initiation of the High Pressure Coolant Injection System. The MSRVs functioned to control reactor pressure. TVA is reporting this event in accordance with 10 CFR 50.73 (a)(2)(iv), as any event or condition that resulted in manual or automatic actuation of any engineered safety feature including the reactor protection system. Corrective actions included personnel corrective action. TVA will place supplemental labels on individual relays. In addition, TVA will issue a design change to increase the response time for the main steam line high flow isolation function.

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FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	2 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

I. **PLANT CONDITIONS**

Units 2 and 3 were at approximately 100 percent power (3293 megawatts thermal). Unit 1 was shutdown and defueled.

II. **DESCRIPTION OF EVENT**

A. **Event**

On April 24, 1997, at 1814 hours Central Daylight Time (CDT), Unit 2 received engineered safety feature actuations (ESF) [JE] and a reactor scram from full power due to a turbine trip caused by a reactor high water level signal.

At 1814 CDT, Instrument Maintenance personnel [utility, nonlicensed] were performing surveillance instruction 2-SI-4.2.B-ATU(C), Core and Containment Cooling Systems Analog Trip Unit Functional Test. As part of the test, Instrument Maintenance personnel were to connect the volt-ohm meter across contacts associated with relay 2-62-3-208C. However, they placed the test leads across contacts associated with relay 2-62-3-208A. Subsequently, the craftsman inserted a trip signal to 2-LS-3-208C and the logic for a high reactor water level trip was completed. The main turbine [TA] and all three reactor feed pumps [SJ] tripped as a result of the high water level trip signal. The reactor automatically scrammed as a result of the turbine trip.

The main steam isolation valves (MSIV) [ISV] closed due to a high main steam line flow signal, PCIS Group 1. This signal was caused by the instrument response to the pressure wave, which resulted from the turbine stop valve closure and process noise from safety relief valve operation.

At 1815 CDT, the unit operator manually initiated Reactor Core Isolation Cooling (RCIC) [BN] to maintain reactor water level. Water level continued to decrease and at 1817 CDT, when level reached -45 inches, the High Pressure Coolant Injection System (HPCI) [BJ] automatically initiated and injected into the vessel.

In addition to the above actuations, the scram resulted in the actuation or isolation of the following Primary Containment Isolation [JE] [PCIS] systems/components.

- PCIS group 2, shutdown cooling mode of Residual Heat Removal [BO] system; Drywell floor drain isolation valve; Drywell equipment drain sump isolation valve [WP].

- PCIS group 3, Reactor Water Cleanup [CE].

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	3 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

- PCIS group 6, Primary Containment Purge and Ventilation [JM]; Unit 2 Reactor Zone Ventilation [VB]; Refuel Zone Ventilation [VA]; Standby Gas Treatment (SGT) [BH] system; Control Room Emergency Ventilation (CREV) [VI].

- PCIS group 8, Transverse Incore Probe [IG].

The reactor scram was reset by 1824 CDT. The affected systems were returned to pre-event status by 1940 CDT. All safety systems responded as expected during the reactor scram, except for the MSIV closure. The MSIV closure is further discussed in Section II.G.

This event is reportable in accordance with 10 CFR 50.73 (a)(2)(iv), as any event or condition that resulted in manual or automatic actuation of any engineered safety feature including the reactor protection system.

B. Inoperable Structures, Components, or Systems that Contributed to the Event:

None.

C. Dates and Approximate Times of Major Occurrences:

April 24, 1997 at 1814 CDT	The Unit 2 Reactor received a full scram due to a turbine trip caused by a reactor high water level signal. An MSIV closure also occurred due to a high steam line flow signal.
April 24, 1997 at 1835 CDT	After verifying that no steam line break had occurred, the operating crew re-opened the MSIVs and re-established the normal heat sink.
April 24, 1997 at 1914 CDT	TVA made a 1 hour nonemergency notification to NRC in accordance with 10 CFR 50.72 (b)(1)(iv) and a 4 hour nonemergency notification to NRC in accordance with 10 CFR 50.72 (b)(2)(ii).
April 24, 1997 at 1920 CDT	The PCIS actuations were reset. SGT and CREV systems are returned to standby readiness.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	4 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

D. **Other Systems or Secondary Functions Affected:**

None.

E. **Method of Discovery:**

The Unit 2 Operator received alarms associated with the full reactor scram and main steam isolation valve closure.

F. **Operator Actions:**

Operator actions taken during this event were as expected. Main steam relief valves (MSRV) [RV] were used to control reactor pressure. RCIC and HPCI were used to increase reactor water level. After verifying that no main steam line break existed, the control room operators opened the MSIVs and re-established the normal heat sink.

G. **Safety System Responses:**

The safety systems listed in section IIA of this report responded to the reactor scram as designed, with the exception of the MSIVs.

An unexpected PCIS [JE] group 1 isolation occurred on high steam flow approximately 500 milliseconds after the turbine trip was initiated. The high flow signal occurred on three of four PCIS channels. This signal was of short duration and subsequently the logic relays dropped out for approximately 20 milliseconds. This action is not expected in a turbine trip event and has not been previously experienced at Browns Ferry.

When a turbine trip occurs, a pressure wave originates at the turbine stop valves and is transmitted back toward the reactor vessel. The magnitude of the pressure exceeds reactor pressure vessel dome pressure because the large volume of the vessel dissipates the pressure wave. Following the reactor scram, MSRVs [RV] 1-31 and 1-34 (both on main steam line C) opened approximately 300 milliseconds after the turbine trip. This was attributed to the passage of the pressure wave through main steam line C. One complete wave cycle is approximately 600 milliseconds as observed on the Integrated Computer System (ICS) [ID]. Opening of MSRVs concurrent with the initial pressure wave cycle would have the effect of increasing the amplitude of the wave. It was also determined from ICS data that the flow indicator for main steam line C had process noise resulting from MSRV operation on that line. TVA believes that the high flow signal was caused by the additive combination of process noise on steam line C flow element and the effects of the passing pressure wave.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	5 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

III. CAUSE OF THE EVENT

A human performance evaluation was conducted and the following causes were identified.

A. Immediate Cause:

The immediate cause of the main turbine trip was a high reactor water level signal. This was followed by a reactor scram.

B. Root Cause:

The root cause of the event was personnel error in that the craftsmen did not perform self-checking continuously. They properly located the relay to be tested but then broke eye contact with the component to physically access the test jacks. While connecting the test leads, the craftsmen focused on connecting the leads to the correct terminal and did not re-verify that they were on the correct relay. Subsequently, the test leads were incorrectly placed on relay 2-62-3-208A instead of relay 2-62-3-208C, as required by the surveillance instruction.

C. Contributing Factors:

Labels identifying relays 2-62-3-208A and -208C are clearly visible from a standing position. However, they are not visible when connecting test equipment to any of the two lower rows of terminals on the relay base.

IV. ANALYSIS OF THE EVENT

This transient was initiated from an unexpected high reactor water level trip signal generated during the performance of a surveillance instruction. The required safety systems performed as needed to properly control the event.

One unexpected equipment response did occur during the transient. Main steam isolation valves are not expected to close after a turbine trip. The main steam isolation valves closed upon receipt of a main steam line high flow signal.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	6 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Closure of MSIVs during a turbine trip transient initiated by the effects of the trip is bounded by existing analyses for turbine trip without bypass, feedwater controller failure, and MSIV closure with flux scram. The transient pressure and flux effects of a turbine trip occur in a much shorter time frame than those of MSIV closure since MSIVs have a closing time of three seconds and both turbine valves and MSIVs interrupt steam flow in the same path. Therefore, the analyzed transients individually produce more limiting results. This event did not affect the health and safety of plant personnel or the public.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

The affected systems were restored to pre-event conditions.

B. Corrective Actions to Prevent Recurrence:

TVA will administer personnel corrective actions in accordance with TVA policy to those involved in the event.

Appropriate maintenance personnel have been briefed on management's expectations for the performance of instruction steps requiring second party verification.

TVA management has instructed instrument maintenance personnel that all components in steps requiring verification must be identified such that if visual contact with the component is subsequently lost, the tag will enable the craftsman to easily locate the correct component.

TVA will issue a design change to increase the response time of main steam line flow instruments[1].

TVA will place supplemental labels under the subject relays to facilitate placement of test leads when required[1].

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1 TVA does not consider these actions Regulatory Commitments. The TVA corrective action program will track completion of the corrective actions.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	7 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

TVA has taken several actions to address the human performance aspect of this and previous events:

- TVA has included specific human performance lessons learned in pre-job briefings.
- In order to focus attention on critical activities, TVA has modified the Scheduled Surveillance sections of the Browns Ferry "Plan of the Day" to indicate which Surveillance Instructions could potentially cause a half-scram, an Engineered Safety Feature, or a turbine trip.
- TVA has increased management observation of the performance of Surveillance Instructions.
- TVA has focused on improving pre-job briefings and making better use of pre-job briefings.
- To foster a deeper sense of accountability for the maintenance shops and crews, TVA has emphasized accountability for personnel actions at the general foreman, foreman, and shop manager level.

VI. ADDITIONAL INFORMATION

A. Failed Components:

None

B. Previous LERs on Similar Events:

The following LERs describe similar events, however, the corrective actions implemented for these events could not prevent the event under consideration.

LER 296/96004: Unplanned Manual Start of Emergency Diesel Generator During a Scheduled Redundant Start Test: During a scheduled performance of the Diesel Generator 3C Redundant Start Test, EDG 3D was manually started from the Unit 3 Main Control Room. When the operator was requested to start EDG 3C, the individual instead started EDG 3D. The root cause of the event was personnel error due to inattention to detail.

LER 260/97002: Unit 3 HPCI System Unexpected Isolation: While performing a surveillance instruction for the functional testing of Unit 3 HPCI steam supply low pressure switches, a volt-ohm meter was inadvertently placed across a wrong pressure switch. The cause of this event was personnel error, as a result of mis-positioning a volt-ohm meter lead. This was the result of a lack of self-checking and second party verification.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Unit 2	05000260	97 --	001 --	00	8 of 8

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

LER 296/96002: Unit 3 Scrammed Following Loss of Reactor Feed Pump 3C: A low reactor water level scram occurred on Unit 3 as a result of the loss of Reactor Feed Pump 3C while aligning RFP 3C's oil purification system. The loss of the reactor feed pump was caused by personnel error. An Assistant Unit Operator improperly aligned oil valves resulting in draining the RFP oil tank.

LER 260/95004: Reactor Scram Resulting From Personnel Error During a Surveillance Test: Unit 2 reactor scrammed during the performance of the 2-SI-4.2.B-ATU(C), Core and Containment System Analog Trip Unit Functional Test. The root cause of the event was personnel error. I&C personnel prematurely repositioned the ATWS mode switch from the 'Test' to the 'Normal' position prior to resetting the ATWS/ARI logic which caused a low scram pilot air header pressure and reactor scram.

VII. COMMITMENTS

TVA will administer personnel corrective actions in accordance with TVA policy to those involved by June 15, 1997.

Energy Industry Identification System (EIIS) system and component codes are identified in the text with brackets (e.g., [XX]).